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Northwestern Ontario Forest Technology Development Unit

Northwestern Ontario Boreal Forest Management

Technical Notes

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CRITICAL SILVICS OF BRACKEN FERN AS RELATED TO VEGETATION MANAGEMENT

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INTRODUCTION

This technical note is designed to assist resource managers in developing site-specific vegetation management strategies. It follows the general format established by Bell (1991) and is one in a series of technical notes intended as addenda to the above mentioned document. Readers may wish to refer to Bell (1991) for background information.

DESCRIPTION

General: Bracken fern (*Pteridium aquilinum* L.) is a large, coarse, weedy fern. The fronds arise singly from a branched creeping rhizome. It often forms extensive patches. Bracken may be up to 1 m high but usually is 50-70 cm (Baldwin and Sims 1989).

Figure 1. Diagram of bracken fern.

Leaves: Leaves are fronds, 30-70 cm long with broadly triangular bipinnate or tripinnate blades and a stiff upright stipe (Figure 1). Leaflets are opposite on the main axis; the lower two are larger and twice divided; upper ones are once divided. Sub-leaflets are alternate with lobed or wavy margins and edges turned under. The leafstalk is woody, dark at the base and straw coloured above but essentially hairless (Baldwin and Sims 1989, Cody and Britton 1989).

Flowers: None.

Fruit: Spores are produced in linear strips along edges of undersides of leaflets.

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VMAP
Vegetation Management Alternatives Program

HABITAT

Figure 2. Distribution of bracken fern in Ontario.

Distribution in Ontario: Across Ontario, north to 45° latitude (Cody and Crompton 1975, Cody and Britton 1989) (Figure 2).

Climate: As bracken is quite frost sensitive (Fraser 1965) its distribution is limited by cold, especially early and late season frosts (Fletcher and Kirkwood 1979). The former kills rhizome and frond apices and the latter shortens the adult life by reducing carbohydrate storage (Watt 1976). Bracken occurs in areas where mean winter temperatures are not below -15°C and summer temperatures average 21°C with variable moisture availability (Cody and Crompton 1975).

Site and Soil Relations: Bracken is generally found on podzols and brunisols (Cody and Crompton 1975). It prefers acid, nutrient deficient soil (Watt 1976) and is often found on poor, deep sandy soil (Page 1976). Its frequency of occurrence across soil textures in northwestern Ontario is shown in Figure 3b.

Nutrient Requirements: Bracken accumulates potassium (Taylor 1990). It is rare on calcium rich soils for unknown reasons (Fletcher and Kirkwood 1979).

Moisture Requirements: Bracken requires moisture; on dry sites fronds are sparse (Watt 1964); however, it cannot tolerate waterlogged soils due to lack of oxygen (Poel 1951, 1961). Its frequency of occurrence on Northwestern Ontario Forest Ecosystem Classification System Vegetation types (Sims *et al.* 1989) is shown in Figure 3a.

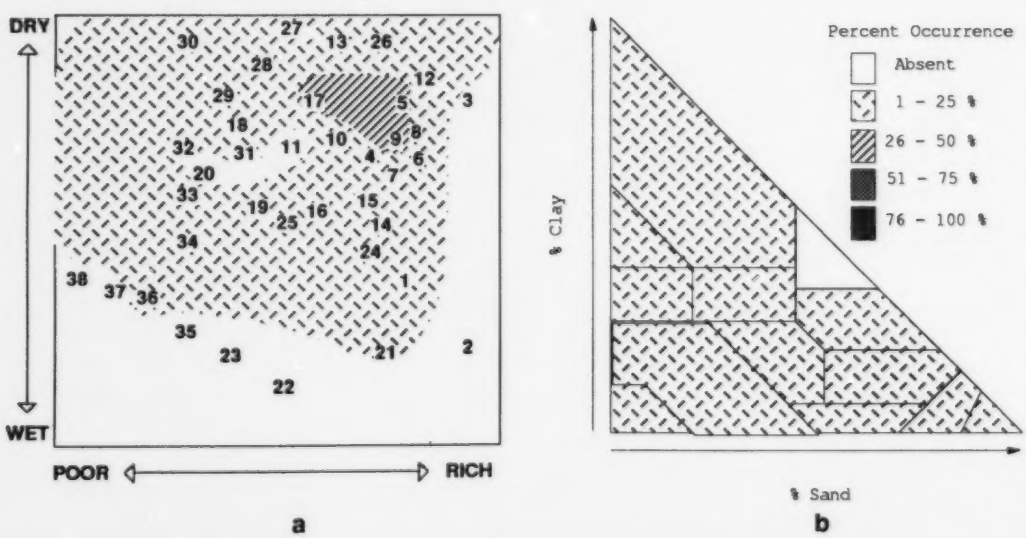

Figure 3. Percent occurrence of bracken fern in northwestern Ontario by a) NWO FEC vegetation type and b) soil texture.

Light Requirements: Bracken can live in the open or under partial shade but is intolerant of dense forest canopy or overstory (Page 1976).

REPRODUCTION

Bracken invades disturbed areas via spores but once established on a site vegetative reproduction is the main means of regeneration.

Spores are produced in sporangia on the underside of the leaflets. They germinate to form a small plant which bears the sexual organs from which new plants are formed (Cody and Crompton 1975).

SEXUAL REPRODUCTION

Seed Production and Dispersal: One frond can produce up to 300,000,000 spores in a season (Conway 1952). Not all fronds produce spores; production is influenced by age, maturity, soil fertility and environmental conditions (Page 1976, Fletcher and Kirkwood 1979). Spore production decreases under shade (Conway 1957). Spores are distributed by wind in late August or early September (Fletcher and Kirkwood 1979). Bracken plants can produce spores as early as their second year (Page 1976).

Seed Viability and Germination Requirements: Spores germinate without any dormancy requirements but only under special conditions. They require a humid, well ventilated area on a slightly acid, sterile medium. They are vulnerable to insects, frost, fungi and drought (Conway 1952). Only a very small proportion of spores germinate (Cody and Crompton 1975).

VEGETATIVE REPRODUCTION

This is the main form of regeneration for bracken. It occurs through fragmentation of the underground stem by rotting or mechanical damage. Each fragment can form a new plant (Cody and Crompton 1975).

New fronds arising from the forking underground stem often appear as separate plants on the surface.

GROWTH AND DEVELOPMENT

In one season, a single spore can result in a plant with a 2 m span (Conway 1952).

Bracken fern has two systems of rhizomes which are linked together; a deep one for food storage and a second layer near the surface from which the majority of fronds arise (Cody and Crompton 1975). Rhizomes can grow up to 2 m per year but average .75 m; they live for 30 to 70 years (Fletcher and Kirkwood 1979). One fifth of underground buds produce fronds in the spring. Dormant buds replace fronds killed by frost, fire and other disturbances (Ferguson and Boyd 1988). New fronds can emerge until mid-July if the initial crop is damaged or killed (Cody and Crompton 1975).

Fronds grow and die in a single season. New fronds are produced each year from underground rhizomes. Fronds yellow before the first killing frost (Cody and Crompton 1975).

PHENOLOGY

Roots, Shoots and Foliage: Rhizomes grow and initiate frond buds in the fall then produce new fronds in the spring (Cody and Crompton 1975).

Fronds generally emerge in mid-May but this is temperature dependent (Cody and Crompton 1975). Carbohydrate levels of frond bearing rhizomes decrease in May. From June to mid-July fronds expand. The carbohydrate content of frond bearing rhizomes stabilizes but that of storage rhizomes decreases. From mid-July to the end of August, carbohydrates increase in both types of rhizome until September when the fronds die. Carbohydrates then increase in the storage rhizomes and decrease in frond bearing rhizomes (Williams and Foley 1975). Fronds take carbohydrates from frond bearing rhizomes first then from storage rhizomes (Fletcher and Kirkwood 1979). Fronds depend on reserves until the second pair of pinnae unfold at 66-75% of full height, following which demand on rhizomes ceases and carbohydrate levels are restored (Hunter 1953).

Reproductive Structures: Spores are produced as early as mid-June but spores on any individual frond will mature at different times (Cody and Crompton 1975).

RESPONSE TO DISTURBANCE

Overstory Removal: Increases the density and vigour of existing colonies (Stanek *et al.* 1979) and creates habitat suitable for invasion by new plants (Fletcher and Kirkwood 1979).

Fire: Burning is most effective if done in mid-June but bracken will sprout from rhizome buds (Taylor 1990). New fronds are produced quickly following hot fires which remove other vegetation (Cody and Crompton 1975). Burning also provides conditions suitable for invasion by spores (Fletcher and Kirkwood 1979).

Mechanical Site Preparation: Deep ploughing provides the best results. Anything that breaks up the rhizome will increase frond density because it encourages sprouting from rhizomes (Conway 1952, Fletcher and Kirkwood 1979). Brand (1991) found that presence and percent cover of bracken were reduced following blading in the Great Lakes St. Lawrence Forest Region.

Cutting: Is more effective if done twice per season (Taylor 1990). For best control, the first cut should be done before fronds are fully expanded; that is, in late June when rhizome reserves have been depeleted; followed by a second cut 6 weeks later to ensure second growth of fronds do not add to carbohydrate reserves (Lowday 1987, Fletcher and Kirkwood 1979). Height and percent cover decrease following cutting but bracken will not be eliminated (Dimock 1964).

Chemical Treatments: Response to herbicides may depend on the 'age' of fronds; that is, whether they originate from old or young rhizomes. Young fronds originate from deeper rhizomes and are taller and more vigorous than older fronds arising from shallow rhizomes (Watt 1976). Open grown bracken may be more susceptible to herbicides than that under a canopy because of increased cuticle thickness in the latter (Daniels 1986).

Bracken is best treated following frond expansion, ie. July to late August, when rhizomes form the main carbohydrate sink (Veeraskaren and Kirkwood 1972). Total herbicide uptake is decreased because of increased cuticle thickness but translocation to the rhizome is maximized (Fletcher and Kirkwood 1979). Herbicide will accumulate in active buds and apices (Lowday 1987).

2,4-D: 3.4 kg/ha applied in August provided no control in Ontario (Campbell 1978b). Some control was provided with 2,4-D applied in water at 2.2 to 3.3 kg a.e./ha in spring or summer in B.C. (Conard and Emmingham 1984).

Hexazinone: Hexazinone supresses bracken when applied at 1.1 to 2.2 kg/ha in spring or summer (Hoolper and Yarborough 1985, Yarborough and Bhowmik 1986). For best results, apply hexazinone following expansion of fronds (Jones and Jones 1980). On coarse textured soils, 2 kg/ha provides 90% control of bracken but on fine textured soils 4 kg/ha is required (Harris and Weidenfeller 1981).

Glyphosate: Glyphosate is more effective than other herbicides because it results in depletion of stored carbohydrates in addition to supressing fronds and killing rhizome apices (Al-Jaff *et al.* 1982). Bracken cover was decreased by summer application of glyphosate at 2 and 4 kg a.i/ha in northern Ontario. The effect was sustained over three years (Sutton 1984). Glyphosate applied at 1.1 kg/ha in early August in Ontario provided 100% control in first and second year following treatment (Campbell 1978a, 1978b).

Glyphosate was found to be moderately effective against bracken fern when applied as a foliar spray from July to September in B.C. (Otchere-Boateng 1990). 1.1 to 1.7 kg a.i./ha applied in late summer resulted in severe injury but 3.3 kg a.i./ha applied in fall resulted in only moderate injury (Conard and Emmingham 1984).

2.2 kg a.i./ha applied in August in Scotland resulted in 97% reduction in frond numbers two years following application (Williams and Foley 1975). Rhizomes may be controlled if timing is correct (Martin 1976); carbohydrate content of storage rhizome reduced if 1.1 to 6.7 kg/ha applied in mid-late August (Williams and Foley 1965).

8 kg/ha applied to fully expanded fronds in New Zealand resulted in browning but did not affect regrowth. However, when applied to expanding fronds following a burn, almost total kill resulted (Chavasse and Davenhill 1973).

Triclopyr: Bracken is resistant to triclopyr applied at 1.1 and 2.2 kg/ha in July or early August (Campbell 1978a, 1978b). Only light injury was afforded by 1.7 kg ae/ha in water in late spring or summer on the west coast (Conard and Emmingham 1984).

EFFECTS ON CONIFERS

Bracken mainly competes with conifers through mechanical damage and smothering rather than competition for resources (Stanek *et al.* 1979, Stewart 1975, Ferguson and Boyd 1988). The mass of rhizomes dominate available rooting space and may reduce moisture availability. The litter, roots and rhizomes may be allelopathic (Watt 1964), mature fronds are not (del Moral and Cates 1971).

Dense fronds and litter suppress ground flora (Fletcher and Kirkwood 1979), but may also smother seedlings and germinants in winter and prevent seeds from reaching forest floor to germinate (Dimock 1964, Watt 1976).

Bracken may prevent erosion on some sites (Martin 1976).

USES BY WILDLIFE

Under normal conditions no species eats bracken to any great extent (Nicholson and Paterson 1976). Rabbits and grouse may eat fronds or rhizomes occasionally. Caribou may browse bracken occasionally. Bracken sometimes provides shelter for small mammals, birds and rabbits.

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